

OSCER State of the Center

Henry Neeman, OSCER Director

hneeman@ou.edu

**OU Supercomputing Center for Education & Research
A Division of OU Information Technology**



Wednesday October 2 2013
University of Oklahoma



Preregistration Profile 2013

- Organizations: 77 preregistered (or speaking)
 - **Academic**: preregistered 33 institutions in 8 states (AR,IL,KS,LA,MO,OK,SD,TX) and one other country (Turkey)
 - Includes 28 institutions in 6 EPSCoR states (AR,KS,LA,MO,OK,SD)
 - **Industry**: preregistered 29 firms
 - **Government**: preregistered 9 agencies (federal, state)
 - **Non-governmental**: preregistered 6 organizations
- Demographics: 286 preregistered (or speaking)
 - 31% OU, 69% non-OU
 - 73% Oklahoma, 27% non-Oklahoma
 - 91% from EPSCoR states, 9% non-EPSCoR
 - 76% academic, 24% non-academic



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Attendee Profile 2002-2012

- Over 3000 attendees at the previous 11 Symposia
 - 69 in 2002, 225-325 per year thereafter
- Organizations: 268 through 2012
 - **Academic**: from 101 institutions in 27 US states & territories
 - 67 institutions in 14 EPSCoR jurisdictions
 - 32 institutions in Oklahoma
 - PhD-granting, masters-granting, bachelors-granting, community college, career tech, high school
 - Historically Black University, Tribal College
 - public, private, for-profit
 - **Industry**: attendees from 119 firms
 - **Government**: attendees from 34 agencies (federal, state, municipal, foreign)
 - **Non-governmental**: attendees from 14 organizations



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Symposium 2013 Sponsors

- Academic sponsors
 - Globus Online
 - Great Plains Network
- Industry sponsors
 - Platinum: Intel
 - Gold: CommScope, Cray, Dell, Graybar, NVIDIA
 - Silver:, DLT Solutions, GovConnection, Red Hat, Tangent
 - Bronze: Advanced Clustering Technologies, DataDirect Networks, Open Technologies, SGI

Thank you all! Without you, the Symposium couldn't happen. Over the past 12 Symposia, we've had a total of 70 companies as sponsors.



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Thank You!

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 - Globus Online
 - Great Plains Network
- Industry sponsors
 - Platinum: Intel
 - Gold: CommScope, Cray, Dell, Graybar, NVIDIA
 - Silver: DLT Solutions, GovConnection, Red Hat, Tangent
 - Bronze: Advanced Clustering Technologies, DataDirect Networks, Open Technologies, SGI

Thank you all! Without you, the Symposium couldn't happen.



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Thanks!

- OU IT
 - OU CIO/VPIT Loretta Early
 - Symposium committee: Josh Alexander (OU), Dana Brunson (OSU), Debi Gentis (OU), Jeff Pummill (U Ark)
 - Symposium coordinator: Debi Gentis
 - Sponsorship coordinator: Chance Grubb
 - OSCER Operations Team: Brandon George, Dave Akin, Brett Zimmerman, Josh Alexander, Patrick Calhoun
 - All of the OU IT folks who helped put this together
- CCE Forum
 - Kristin Livingston, Deborah Haddock
 - The whole Forum crew who helped put this together



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Thanks: Plenary Speakers

- Plenary Speakers
 - Mike Little, NASA (couldn't attend)
 - Rachana Ananthakrishnan, University of Chicago/Argonne National Laboratory Computation Institute, Globus Online
 - John Shalf, Lawrence Berkeley National Laboratory/National Energy Research Scientific Computing Center
 - Stephen Wheat, Intel (Platinum sponsor)



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Thanks: Gold Sponsor Speakers

- Bob Crovella, NVIDIA
- Jason Goodman, Cray, Inc.
- Darren King, Spectra Logic
- Kevin Paschal, CommScope



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Thanks: Breakout Speakers

- Dan Andresen, KSU
- Workalemahu Berhanu, OU
- Shane Corder, Children's Mercy Hospital
- Carl Grant, OU
- Louisiana School for Math, Science and the Arts
- George Louthan, Oklahoma Innovation Institute
- Greg Monaco, Great Plains Network
- Fatih Yasar, Hacettepe U/OU



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Thanks!

To all of you for participating, and to those many of you who've shown us so much loyalty over the past 12 years.



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Some Accomplishments

- **NEW!** Funded grants
 - NSF EPSCoR RII Track-1 started June 1 (submitted the same day as last year's Symposium)
 - NSF CC-NIE networking grant: started yesterday!
- **NEW!** OU Research Cloud
- OneOklahoma Cyberinfrastructure Initiative has reached 50 academic and 48 non-academic institutions and organizations.
- **NEW!** OneOklahoma Research Data Stewardship Initiative
- “A Day in the Life of an IT Professional” talks: so far 83 visits to or from 36 institutions, to over 1600 students.



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Outline

- OU
 - Resources
 - Accomplishments
- OCII/OneOCII



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Resources



Dell Intel Xeon Linux Cluster

874 Intel Xeon CPU chips/6992 cores

Photo: Jawanza Bassue

412 dual socket/oct core Sandy Bridge 2.0 GHz, 32 GB

23 dual socket/oct core Sandy Bridge 2.0 GHz, 64 GB

1 quad socket/oct core Westmere, 2.13 GHz, 1 TB

15,680 GB RAM

~360 TB global disk

QLogic Infiniband

(16.67 Gbps, ~1 microsec latency)

Dell Force10 Gigabit/10G Ethernet

Red Hat Enterprise Linux 6

Peak speed: 111.6 TFLOPs*

*TFLOPs: trillion calculations per second



Just over 3x (300%) as fast as our 2008-12 supercomputer.

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Just over 100x (10,000%) as fast as our first cluster supercomputer in 2002.



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Dell Intel Xeon Linux Cluster

874 Intel Xeon CPU chips/6992 cores

Photo: Jawanza Bassue

412 dual socket/oct core Sandy Bridge 2.0 GHz, 32 GB

23 dual socket/oct core Sandy Bridge 2.0 GHz, 64 GB

1 quad socket/oct core Westmere, 2.13 GHz, 1 TB

15,680 GB RAM

~360 TB global disk

QLogic Infiniband

(16.67 Gbps, ~1 microsec latency)

Dell Force10 Gigabit/10G Ethernet

Red Hat Enterprise Linux 6

Peak speed: 111.6 TFLOPs*

*TFLOPs: trillion calculations per second



19% of the nodes are

“condominium” (owned by individual research teams): ~4x as many as all OSCER’s previous clusters combined.

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OU Research IT Personnel

- OSCER
 - Director: Henry Neeman
 - Associate Director for Remote & Heterogeneous Computing: Horst Severini
 - Manager of Operations: Brandon George
 - Senior System Administrator: David Akin
 - Senior System Administrator: Brett Zimmerman
 - HPC Application Software Specialist: Josh Alexander
 - Research IT Coordinator: Debi Gentis
 - Petascale Storage Administrator: Patrick Calhoun
 - **NEW!** Student Hardware Techs: Paulius Velesko, Matt Borba



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OU Research IT Personnel

- Informatics
 - Jonah Duckles
 - Mark Stacy
 - **NEW!** Katy Franks (undergraduate)
- **NEW!** Integrated Robust Assured Data Services (IRADS)
 - Carl Sinclair



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New Building!

Four Partners Place: just past SRTC, where we were last night
We moved into our offices in late Nov 2012, and moved
Boomer into the data center in Jan 2013.



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Accomplishments





External Research Grants

1. J. Wicksted, A. Knoedler et al, "Adapting Socio-ecological Systems to Increased Climate Variability," NSF, \$20M + \$4M Regents (total), \$7.0M + \$1.9M Regents (OU)
2. M. Engle et al, "Resilience and vulnerability of beef cattle production in the Southern Great Plains under changing climate, land use and markets," \$9.5M (total), \$1.9M (OU)
3. R. Palmer, G. Zhang, Y. Zhang, T. Yu, M. Yeary, S. Karimkashi, C. Fulton, B. Cheong, "Multi-Mission Phased Array Radar Risk Reduction: A Collaborative Effort with the ARRC at the University of Oklahoma," NOAA, \$1.5M
4. R. Palmer, G. Zhang, Y. Zhang, T. Yu, M. Yeary, Y. Hong, J. Crain, P. Chilson, "Next Generation Weather Radar Technology," NOAA, \$900K
5. R. Palmer, D. Bodine, S. Torres, B. Cheong, C. Fulton, "Understanding Polarimetric Radar Tornadic Debris Signatures Using Modeling, Simulations, and Field Measurements,," NSF, \$860K
6. A. Callaghan, "Elucidation of Alkene Metabolism in Two Sulfate-reducing Isolates via Metabolite Profiling and Transcriptomics," NSF, \$848K
7. D. LaDue, K. Kloesel, "REU Site: Research Experiences for Undergraduates at the National Weather Center," NSF, \$822K
8. J. Brotzge, M. Xue, N. Snook, Y. Jung, A. McGovern, "The Severe Hail Analysis, Representation, and Prediction (SHARP) Project," NSF, \$819K
9. L. Krumholz, J. Zhou, M. McInerney, J. Wall, "Characteristics of H2 Producing Biological Systems Operating at 1 nM H2 Concentration," DOE, \$819K (total), \$693K (OU)
10. P. Chilson, E. Fedorovich, R. Palmer, "Studies of the Atmospheric Boundary Layer Using Numerical Simulations Coupled With Radar/Sodar-Based Field Experiments," NSF, \$757K
11. M. Xue, K. Brewster, F. Kong, "Establishment of Precision Weather Analysis and Forecasting Systems (PWAFS) for the Jiangsu Province Meteorological Bureau (JSMB)," NRIET, \$505K
12. H. Neeman, D. Brunson, J. Deaton, S. Radhakrishnan et al, "CC-NIE: OneOklahoma Friction Free Network," NSF, \$500K
13. F. Kong, M. Xue, "Further Development of the Storm-Scale Numerical Weather Prediction Capability for Shenzhen Meteorological Bureau," Shenzhen, \$479K
14. E. Bridge, J. Kelly, "Optimizing Grassland Bird Conservation in an Era of Biofuel Production," USDA, \$466K

OSKER-RELATED FUNDING TO DATE:

\$259M total, \$145M to OU

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External Research Grants (cont'd)

- 15. R. Kolar, "Dynamic Integration of Natural, Human, and Instructure Systems for Hurricane Evacuation and Sheltering," NSF, \$456K
- 16. L. Ding, "Neuroimaging Study of Mental Fatigue," FAA, \$430K
- 17. U. Hansmann, "Development of Generalized-Ensemble Algorithms and their Application in Protein Studies," NSF, \$410K
- 18. L. Ding, "Large-Scale Computational Neuroimaging of Brain Electrical Activity," NSF CAREER, \$400K
- 19. P. Attar, "Optimal Spatiotemporal Reduced Order Modeling for Nonlinear Structural Dynamics," NSF, \$360K
- 20. B. L. Cheong, Y. Jung, G. Zhang,, "Support for X-band Solid-state Weather Radar Development," WeatherLink, \$334K
- 21. P. Vedula, P. J. Attar, "Fast simulations of turbulent flows based on spatiotemporal statistical information," NSF, \$330K
- 22. M. Xue, K. Brewster, F. Kong, "Development of a Short-Range Realtime Analysis and Forecasting System based on the ARPS for Taiwan Region Year 3 (IA#24) and Year 4 (IA #25)," NOAA, \$310K
- 23. E. Bridge, J. Kelly, X. Xiao, "Enhancing and disseminating miniaturized tracking technology for widespread use on small migratory songbirds," NSF, \$302K
- 24. J. Kelly, L. Gruenwald, P. Chilson, V. Lakshmanan, E. Bridge, "Advancing Biological Interpretations of Radar Data," NSF EAGER, \$299K
- 25. L. Ding, "High-Resolution Noninvasive Computational Neuroimaging," OCAST, \$283K
- 26. F. Kong, "Further Development to the Storm-Scale Numerical Weather Prediction Capability for Shenzhen Meteorological Bureau," SIATCAS, \$251K
- 27. R. Slatt, Consortium from 14 oil and gas company, \$245K
- 28. J. Brotzge, F. Carr, "Prototyping and Evaluating Key Network-of-Networks Technologies: Project Extension," NOAA, \$210K
- 29. Y. Jung, M. Xue, G. Zhang, "Development of a Polarimetric Radar Data Simulator for KLAPS," KMA, \$176K
- 30. J. Ruyle, "BRIGE: Investigation of Slot Antenna Recon figuration Mechanisms," NSF, \$175K
- 31. J. Brotzge, F. Carr, "CASA Warning System Innovation Institute," U Mass, \$160K

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External Research Grants (cont'd)

32. J. Kelly, "Developing Innovative Tools to Use Weather Radar Data to Assess and Monitor Impacts of Existing and Future Energy Facilities on Aerial Faunas in California," CIEE, \$150K (total), \$49K (OU)
33. J. Brotzge, F. Carr, "Prototyping and Evaluating Key Network-of-Networks Technologies," NOAA, \$145K
34. T. Yu, Y. Wang, R. Palmer, B. Cheong, "Algorithm development for solid-state polarimetric weather radars," Toshiba, \$130K
35. M. Xue, K. Brewster, F. Kong, "Establishment of an Urban-Scale Weather Forecasting System (USWFS) for the Su Zhou Meteorological Bureau (SZMB)," \$127K
36. L. Ding, "Neurophysiological Assessment of Mental Fatigue and Cognitive Performance," FAA, \$115K
37. K. Dresback, R. Kolar, "Next Generation ADCIRC Tidal Database: Phase 2 - West Coast," DOD, \$75K
38. K. Dresback, R. Kolar, "Next Generation ADCIRC Tidal Database," NOAA, \$75K
39. P. Risser, J. Duckles, J. Bratton, NSF I-Corps, \$50K
40. R. Palmer, M. Yeary, "System and Software Engineering Support Services for CGI," CGI, \$46K
41. M. Yeary, M. Xue, "GRDS: Request to support a Native American Indian graduate student beginning his PhD within the CASA Engineering Research Center," NSF, \$32K

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External Research Grants (cont'd)

- 42. I.Y. Akkutlu, J. Callard, C. Rai, C. Sondergeld, "OU Shale Gas and Unconventional Reservoir Research Cooperative," \$2.8M per year
- 43. J. P. Shaffer, T. Pfau, "A Rydberg Atom Electric Field Sensor," DARPA-ARO, \$1.18M (total), \$1.06M (OU)
- 44. Y. Luo, "Data Synthesis and Data Assimilation at Global Change Experiments and Fluxnet toward Improving Land Process Models," DOE, \$1.05M
- 45. F. Kong, M. Xue, K. Brewster, "Establishment of an Improved Numerical Weather Forecasting System for Chongqing Meteorological Service," Chongqing Institute of Green and Intelligent Technology, China, \$852K
- 46. G. Zhang, M. Xue, B. L. Cheong, T. J. Schurr, "Advanced Study of Precipitation Microphysics with Multi-Frequency Polarimetric Radar Observations and Data Assimilation," NSF, \$637K
- 47. J. P. Shaffer, "A Quantum Hybrid System for Linking Rydberg Atom Quantum Gates. NSF, \$465K
- 48. J. P. Shaffer, "Rydberg Atom Interactions and Collective Behavior," NSF, \$436K
- 49. J. P. Shaffer, "Interactions in Cold Rydberg Gases," NSF, \$422K
- 50. J. Cruz, "CIF: Small: Two-Dimensional Channel Modeling, Detection and Coding for Shingled Magnetic Recording," NSF, \$418K
- 51. M. Yuan, "Supplement to Developing and Evaluating the Effectiveness of the Location-based Offender Monitoring System for Offender Supervision," National Institute of Justice, \$396K
- 52. X. Wang, M. Xue, F. Kong, "Optimal Design of Multi-scale Ensemble Systems for Convective-Scale Probabilistic Forecasting," NSF, \$359K
- 53. F. Kong, M. Xue, "Further Development of the Storm-Scale Numerical Weather Prediction Capability for Shenzhen Meteorological Bureau," Shenzhen Institute of Advanced Technology, China, \$251K
- 54. J. Snow & F. Fondjo Fotou (Langston U), "MRI: Acquisition of a High Performance Computing Cluster for Research and Education," NSF, \$250K
- 55. M. Xue, K. Brewster, Y. Jung, "Advanced Data Assimilation and Prediction Research for Convective-Scale Warn-on-Forecast," NOAA, \$243K
- 56. I.Y. Akkutlu, "Multi-scale Characterization of Transport Phenomena in Shales for Improved Gas Recovery," Devon Energy, \$200K
- 57. M. Xue, R. McPherson, J. Brotzge, B. Moore, "Very High-Resolution Dynamic Downscaling of Regional Climate and Hydrology," USG, \$24K
- 58. J. Brotzge, F. Carr, "CASA DFW Testbed Enhancement: Task B of National Mesonet Program (NWP)," Earth Networks Inc., \$25K

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External Research Grants (cont'd)

- 59. R. Voronov, "Intra-Thrombus Chemo-Transport and Local Stress Mechanics under Flow," American Heart Association Postdoctoral Fellowship, \$150K
- 60. X. Wang, M. Xue, "Improving High Resolution Tropical Cyclone Prediction using GSI-based Hybrid Ensemble-Variational Data Assimilation System for HWRF," NOAA, \$150K
- 61. I. Y. Akkutlu, "Molecular Theory of Capillarity in Kerogen - A Multi-component Approach to Predict Shale Gas/Liquid In-place and Transport in Nanopores," Devon Energy, \$150K
- 62. S. Dhall, L. Gruenwald, "Autonomous Database Partitioning using Data Mining for High End Computing," NSF, \$150K
- 63. M. Xue, K. Brewster, F. Kong, "Ensemble Simulation of GOES-R Proxy Radiance Data from CONUS Storm-Scale Ensemble Forecasts, Product Demonstration and Assessment at the Hazardous Weather Testbed GOES-R Proving Ground," NOAA, \$126K
- 64. M. Xue, K. Brewster, F. Kong, "Ensemble Simulation of GOES-R Proxy Radiance Data from CONUS Storm-Scale Ensemble Forecasts, Product Demonstration and Assessment at the Hazardous Weather Testbed GOES-R Proving Ground," NOAA, \$94K
- 65. K. Brewster, M. Xue, "High Resolution Data Assimilation for Trajectory Improvement," DOD-Air Force, \$79K
- 66. F. Kong, "CAPS support to the WRF Lightning Forecast Algorithm for the NOAA R3 effort," NOAA GOES-R/Universities Space Research Assn, \$48K
- 67. R. McPherson, M. Shafer, Y. Hong, "Utilization of Regional Climate Science Programs in Reservoir and Watershed Impact Assessments," OSU Water Resources Responses to Climate Change: Pilot Study, \$43K
- 68. P. Attar, "Numerical Simulation of a Membrane Micro Air Vehicle in a Gust Field, Ohio Aerospace Institute, \$35K
- 69. J.R. Cruz, "Signal Processing for Magnetic Recording Channels," Hitachi Global Storage Technologies, Inc., Director, \$30K
- 70. J.R. Cruz, "Equalization, Detection, and Coding Algorithms for Bit Patterned Media Recording," Advanced Storage Technology Consortium, \$17K
- 71. L. Sells, J. Goulden, H. Aboudja, "LittleFe grant," LittleFe project, \$2.5K
- 72. L. Sells, J. Goulden, "Early Adopter Grant," NSF/TCPP, \$2.5K

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External Research Grants (cont'd)

- 73. B. Moore III et al, "Department of the Interior South-Central Regional Climate Science Center," US Dept of the Interior, \$3.5M (total), \$1.4M (OU)
- 74. A. Striolo, D. Resasco et al, "Center for Application of Single-Walled Carbon Nanotubes," DOE, \$1M
- 75. J. K. Shen, "CAREER: Electrostatic Mechanisms in Protein Stability and Folding," NSF, \$773K
- 76. Y. Kogan, "Parameterization of cumulus convective cloud systems in mesoscale forecast models," ONR, \$594K
- 77. X. Wang, M. Xue, F. Kong, "Optimal Design of Multi-scale Ensemble Systems for Convective-Scale Probabilistic Forecasting," NSF, \$395K
- 78. R. D. Palmer, T.-Y. Yu, "NMQ and WDSS-II for the KMA radar network: Real-time, effective, and integrated weather products," Space Environment Laboratory, Inc., \$361K
- 79. B. Grady, A. Striolo, "Novel Supramolecular Structures of Laterally Confined Amphiphilic Molecules," NSF, \$335K
- 80. D. Resasco, D. Papavassiliou et al, "Interfacially active SWNT/silica nanohybrids," Advanced Energy Consortium, \$331K
- 81. C. Y. Tang , R. Ramakumar, N. Jiang , "Control and Operation of Large-Scale Wind Farms in the Power System", NSF, \$231K
- 82. J. Shen, "Electrostatic Modulation of Protein Stability and Folding," NIH, \$1.4M
- 83. Y. Wang, "Theoretical Tools for Measuring Dark Energy from Galaxy Clustering," DOE, \$230K
- 84. F. Kong, M. Xue, "Further Enhancement to the Hourly Assimilation and Prediction System (HAPS) for Shenzhen Meteorological Bureau." Shenzhen Institute of Advanced Technology, Chinese Academy of Science, \$228K
- 85. P. Attar, P. Vedula, "Multi-fidelity Modeling and Simulation (M&S) Tool for Nonlinear Aeroelasticity," Advanced Dynamics, \$160K
- 86. B. Eskridge, "CDI-TYPE I: RUI: Emergent Hierarchies of Leaders in Multi-Robot Systems," NSF, \$159K
- 87. A. Striolo, "Mixed-Volatile Fluids Relevant to Subsurface Energy Systems," DOE, \$120K
- 88. P. Skubic, M. Strauss, "OU Contribution to the ATLAS Southwest Tier 2 Computing Center (Supplement)," NSF, \$110K
- 89. P. Attar, "High-Fidelity Computational Aeroelastic Solver Research," Ohio Aerospace Institute, \$53K
- 90. P. Skubic, M. Strauss, "OU Contribution to the ATLAS Southwest Tier 2 Computing Center (Supplement)," NSF, \$50K

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External Research Grants (cont'd)

91. P. Skubic, M. Strauss, "University of Oklahoma Contribution to OSG Software Development," Brookhaven National Laboratory, \$50K.
92. P. Attar, "Computational Model Development and Experimental Validation Measurements for Membrane-Batten Wing," Ohio Aerospace Institute, \$43K
93. A. Striolo, "Reduced Carbon in Earth's Crust and Mantle I," Alfred P. Sloan Foundation, \$39K.
94. J. Gao, "Advancing Research on Realtime Weather-Adaptive 3DVAR Analyses with Automatic Storm Positioning and On-demand Capability," NOAA, \$36K
95. M. Xue, "Probabilistic Forecasting for Aviation Decision Aid Applications," Impact Technologies, \$20K
96. P. Attar, P. Vedula, "Towards Better Modeling and Simulation of Nonlinear Aeroelasticity On and Beyond Transonic Regimes," Advanced Dynamics, \$20K
97. P. Attar, P. Vedula, "High-Fidelity Computational Aeroelastic Models in Support of Certification Airworthiness of Control Surfaces with Freeplay and Other Nonlinear Features," Advanced Dynamics, \$9K

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External Research Grants (cont'd)

- 98. H. Neeman, D. Brunson (OSU), J. Deaton (OneNet), J. He (Noble Foundation), D. Schoenefeld (TU), J. Snow (Langston U), M. Strauss (OU), X. Xiao (OU), M. Xue (OU), "Oklahoma Optical Initiative," NSF, \$1.17M
- 99. H. Neeman, M. Jensen, M. Strauss, X. Xiao, M. Xue, E. Baron, K. Dresback, R. Kolar, A. McGovern, R. Palmer, D. Papavassiliou, H. Severini, P. Skubic, T. Trafalis, M. Wenger, R. Wheeler (Duquesne U), "MRI: Acquisition of Extensible Petascale Storage for Data Intensive Research," NSF, \$793K
- 100. D. Resasco, J. Harwell, F. Jentoft, K. Gasem, S. Wang, "Center for Interfacial Reaction Engineering (CIRE)," DOE EPSCoR, \$2.4M (\$1.97M OU)
- 101. P. Skubic, M. Strauss, B. Abbott, P. Gutierrez, "Experimental Physics Investigations Using Colliding Beam Detectors at Fermilab and the Large Hadron Collider (LHC) (TASK A) 2010-2013 Renewal," DOE, \$2.8M
- 102. R. Palmer, Y. Zhang, G. Zhang, T. Yu, M. Yearly, Y. Hong, J. Crain, P. Chilson, "Next Generation Phased Array," NSSL, \$2M
- 103. P. Skubic, M. Strauss, B. Abbott, P. Gutierrez, "Experimental Physics Investigations Using Colliding Beam Detectors at Fermilab and the Large Hadron Collider (LHC) (TASK A) 2010-2013 Renewal-Revision," DOE, \$1.52M
- 104. D. Cole, Alberto Striolo, "Structure and Dynamics of Earth Materials, Interfaces and Reactions," DOE, \$1.5M (\$90K OU)
- 105. R. Sigal, F. Civan, D. Devegowda, "Simulation of Shale Gas Reservoirs Incorporating the Correct Physics of Capillarity and Fluid Transport," Research Partnership to Secure Energy for America (RPSEA), \$1.05M
- 106. M. Biggerstaff, J. Straka, L. Wicker, Zrnica, Zahari, "MRI Development of C-Band Mobile Polarimetric Weather Radars," NSF, \$989K (\$439K OU)
- 107. D. Resasco, D. Papavassiliou et al, "Carbon Nanotube Technology Center," DOE, \$925K
- 108. M. Saha, D. Papavassiliou, A. Striolo, K. Mullen, B. Grady, C. Altan, D. Resasco, "Experimental and theoretical studies of carbon nanotube hierarchical structures in multifunctional polymer composites," DoD-EPSCoR, \$897K
- 109. E. Mansell, J. Straka, C. Ziegler, D. MacGorman, "Numerical modeling studies of storm electrification and lightning," NSF, \$817K
- 110. E. Rasmussen, J. Straka, K. Kanak, "Collaborative Research: Challenges in understanding tornadogenesis and associated phenomena, \$755K (\$489K OU)
- 111. J. Straka, K. Kanak, "Challenges in tornadogenesis and associated phenomena," NSF, \$584K

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External Research Grants (cont'd)

- 112. M. Xue, F. Kong, "Advanced Multi-Moment Microphysics for Precipitation and Tropical Cyclone Forecast Improvement with COAMPS," ONR, \$592K
- 113. J. Straka, K. Kanak, "Collaborative Research: Challenges in Understanding Tornadoogenesis and Associated Phenomena," NSF, \$515K
- 114. D. MacGorman, E. Mansell, C. Ziegler, A. Fierro, M. Xue, "Techniques for Assimilating Geostationary Lightning Mapper Data and Assessment of the Resulting Impact on Forecasts," NOAA, \$415K
- 115. M. Xue, F. Kong, K. Brewster, X. Wang, "A Partnership to Develop, Conduct, and Evaluate Realtime High-Resolution Ensemble and Deterministic Forecasts for Convective-scale Hazardous Weather: Moving to the Next Level," NOAA CSTAR, \$375K
- 116. M. Xue, K. Brewster, J. Gao, X. Wang, "Advanced Data Assimilation and Prediction Research for Convective-Scale 'Warn-on-Forecast,'" \$500K, NOAA
- 117. X. Wang, "Improving satellite radiance data assimilation using a hybrid ensemble-Gridpoint Statistical Interpolation (GSI) method for global numerical weather prediction," NASA, \$276K
- 118. X. Wang, M. Xue, "Improving NOAA operational global numerical weather prediction using a hybrid-ensemble Kalman filter data assimilation and ensemble forecast system," NOAA, \$207K
- 119. D. Resasco, D. Papavassiliou et al, "Interfacially active SWNT/silica nanohybrids," Advanced Energy Consortium (AEC), \$333K
- 120. D. Oliver, "Data analysis and inversion for mobile nanosensors," AEC, \$320K
- 121. R. Palmer, T. Yu, G. Zhang, M. Yearly, P. Chilson, Y. Zhang, J. Crain, "Advancements in Phased Array Weather Radar Research at OU," NOAA National Severe Storms Laboratory (NSSL), \$270K
- 122. A. Striolo, "The Emergent Behavior of Solid Nanoparticles at Oil-Water Interfaces: A Multi-Scale Thermodynamic Approach to Enable Bio-Oil Upgrade," NSF, \$238K
- 123. M. Xue, K. Brewster, F. Kong, "Development of a Short-Range Realtime Analysis and Forecasting System based on the ARPS for Taiwan Region," NOAA, \$200K
- 124. J. Straka, K. Kanak, "Formative dynamics of the mammatus clouds in thunderstorm cirrus," NSF, \$318K
- 125. M. Yearly, C. Tang, "Computationally Efficient Linear Transforms for Remote Sensing Systems," NSF, \$299K
- 126. A. Striolo, "Probing regular solution theory for mixed amphoteric/ionic surfactant systems by molecular dynamics simulations," ACS, \$100K

OSKER-RELATED FUNDING TO DATE:

\$259M total, \$145M to OU

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External Research Grants (cont'd)

- 127. K. Brewster, M. Xue, F. Kong, meteorology project, \$211K
- 128. M. Xue, meteorology project, \$120K
- 129. A. McGovern, "Learning to guide search in large state spaces," IBM DARPA, \$95K
- 130. J. Straka, K. Kanak, "Supplement: Challenges in tornadogenesis and associated phenomena (VORTEX2)," NSF, \$87K
- 131. F. Kong, M. Xue, "Establishment of an Experimental Real-Time Short-Term Storm Prediction System for Shenzhen Meteorological Bureau," \$58K
- 132. J. Straka, "Improved Understanding/Prediction of Severe Convective Storms and Attendant Phenomena through Advanced Numerical Simulation," NSF, \$58K
- 133. M. Xue, "Assimilation of NEXRAD Radial Winds in a Regional Mesoscale Model," Miss State U, \$79K
- 134. J. Cruz, R. Todd, "Medium-Density Parity-Check Codes for Tape Systems," INSIC, \$36K
- 135. M. Xue, D. Stensrud, J. Gao, "Advancing Warn on Forecast – Storm-scale Analysis of Vortex 2 Thunderstorms," NSSL, \$70K
- 136. P. Attar, "High-Fidelity Computational Aeroelastic Solver Research," Ohio Aerospace Institute, \$60K
- 137. J. Straka, K. Kanak, "Development of Unmanned Aircraft System for Research in a Severe Storm Environment and Deployment within the VORTEX 2," NSF, \$44K
- 138. J. Cruz, "Equalization, Detection, and Coding Algorithms for Bit Patterned Media Recording Channels," International Storage Industry Consortium (INSIC), \$35K
- 139. J. Cruz, R. Todd, "Signal Processing for Magnetic Recording Channels," private company, \$30K
- 140. P. Attar, P. Vedula, "Deterministic and Statistical Characterization of the Impact of Control Surface Freeplay on Flutter and Limit-Cycle Oscillation (LCO) using Efficient Computational Modeling," Advanced Dynamics, \$30K
- 141. P. Attar, P. Vedula, "Novel Reduced Order in time Models for Problems in Nonlinear Aeroelasticity," Advanced Dynamics, \$29K
- 142. F. Carr, J. Straka, "Severe storm research," Jonathon Merage Foundation, \$21K
- 143. F. Carr, J. Straka, "Severe storm research," Jonathon Merage Foundation, \$20K

OSKER-RELATED FUNDING TO DATE:

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External Research Grants (cont'd)

- 144. A. Striolo, "Electrolytes at Solid-Water Interfaces: Theoretical Studies for Practical Applications," DOE EPSCoR, \$450K
- 145. A. Striolo, Saha, "Experimental and Theoretical Studies of Carbon Nanotube Hierarchical Structures in Multifunctional Polymer Composites," DOD EPSCoR, \$450K
- 146. D. Cole (ORNL), A. Striolo, "Structure and Dynamics of Earth Materials, Interfaces and Reactions," DOE, \$1.5M (\$75K OU)
- 147. D. Papavassiliou, A. Striolo, "Effects of Hydrophobicity-Induced Wall Slip on Turbulence Drag and Turbulence Structure," NSF, \$230K
- 148. A. Striolo, D. Resasco, U. Nollert, "Understanding the Interactions between Carbon Nanotubes and Cellular Membranes," NSF, \$380K
- 149. M. Xue, Y. Hong, X. Hu (GSU), "Integrated Weather and Wildfire Simulation and Optimization for Wildfire Management," NSF, \$997K (\$483K OU)
- 150. Y. Hong, "Next Generation QPE: Toward a Multi-Sensor Approach for Integration of Radar, Satellite, and Surface Observations to Produce Very High-resolution Precipitation Data," NOAA/OAR/NSSL via CIMMS, \$83K
- 151. R. Palmer, Y. Hong, "Phased Array Technology for Weather Radar Applications," NOAA/OAR/NSSL via CIMMS, \$426K
- 152. Y. Hong, Baski (OSU), "Proactive approach to transportation resource allocation under severe winter weather emergencies," OK-DOT/OTC, \$261K (\$101K OU)
- 153. R. Palmer, Y. Hong, "Atmospheric Observations using PhasedArray Technology," \$340K
- 154. Y. Hong, "Toward Improved Flood Prediction and Risk Mitigation: Capacity Building for Africa," NASA, \$87K
- 155. Y. Hong, "Improving NASA Global Hazard System and Implementing SERVIR-Africa," NASA, \$272K
- 156. Y. Hong, "Link SERVIR-Africa Work to NASA Land Information System: Workshop Training and Data Assimilation of GRACE to NASA-OU Hydrologic Model," NASA, \$10K
- 157. R. Adler (NASA), Y. Hong, "Global Hazard (Flood-Landslide) Decision-Support System," NASA, \$900K
- 158. S. Schroeder, "CAREER: Advancing Viral RNA Structure Prediction," NSF, \$750K

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\$259M total, \$145M to OU

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External Research Grants (cont'd)

- 159. P. Attar, "High Fidelity Computational Aeroelastic Analysis of a Flexible Membrane Airfoil Undergoing Dynamic Motion," Ohio Aerospace Institute, \$35K
- 160. P. Attar, "Computational Model Development and Experimental Validation Measurements for Membrane-Batten Wing" Flexible Membrane Airfoil Undergoing Dynamic Motion," Ohio Aerospace Institute, \$43K
- 161. K. Droegemeier, F. Kong, P. Attar, "A Partnership to Develop, Conduct, and Evaluate Realtime High-Resolution Ensemble and Deterministic Forecasts for Convective-scale Hazardous Weather," NOAA, \$375K
- 162. M. Xue, G. Zhang, K. Brewster, F. Kong, "Prediction and Predictability of Tropical Cyclones over Oceanic and Coastal Regions and Advanced Assimilation of Radar and Satellite Data for the Navy Coupled Ocean-Atmosphere Mesoscale Prediction System," ONR/DOD EPSCoR, \$476K; OK Board of Regents \$100K
- 163. S. Ahalt, A. Apon, D. Lifka, H. Neeman, "NSF Workshop High Performance Computing Center Sustainability," NSF, \$49K (\$0 OU)
- 164. Y. Luo, S. Lakshmivarahan, "Development of a Data Assimilation Capability towards Ecological Forecasting in a Data-Rich Era," NSF, \$1.08M
- 165. Y. Luo, D. Schimmel (NEON), J. Clark (Duke U.), Kiona Ogle (U. Wyoming), S. LaDeau (Cary Institute of Ecosystem Study), "RCN: Forecasts Of Resource and Environmental Changes: Data Assimilation Science and Technology (FORECAST)," NSF, \$500K
- 166. J. Straka, K. Kanak, Davies-Jones, H. Neeman, "Challenges in understanding tornadogenesis and associated phenomena," NSF, \$854K
- 167. P. Risser et al, "A cyberCommons for Ecological Forecasting," NSF, \$6M (\$2.78M OU)
- 168. M. Xue, X. Wang, X. Li (OSU), R. Barnes, S. Sanielevici (PSC), H. Neeman, "Enabling Petascale Ensemble-Based Data Assimilation for the Numerical Analysis and Prediction of High-Impact Weather," NSF, \$1.2M (\$902K OU)
- 169. P. Skubic, B. Abbott, P. Gutierrez, M. Strauss, "ATLAS Southwest Tier 2 Computing Center," NSF, \$600K/year (\$60K/year OU)
- 170. Y. Hong, "Evaluation of NASA Global Hazard System," NASA, \$45K

OSKER-RELATED FUNDING TO DATE:

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External Research Grants (cont'd)

- 171. J Wicksted, F. Waxman et al, "Building Oklahoma's Leadership Role in Cellulosic Bioenergy," NSF EPSCoR, \$15M (\$5.7M OU)
- 172. D.S. Oliver, software, \$16.7M
- 173. K.K. Muraleetharan, G. Miller, and A. Cerato, "Understanding and Improving the Seismic Behavior of Pile Foundations in Soft Clays," NSF, \$1.15M (\$500K OU)
- 174. K. Droegemeier, F. Kong, "Multisensor Studies of Precipitation for Model Verification and Data Assimilation," U Minn, (\$7K OU)
- 175. K. Droegemeier, M. Xue, F. Kong, "Observing System Simulation Experiments for Airborne Weather Sensors," HRL, (\$33K OU)
- 176. M. Nollert, Scholarship, FD-OMRF, \$12K
- 177. R. Sigal, R. Philp, C. Rai., S. Shah, R. Slatt, C. Sondergeld, D. Zhang, energy company, \$1.9M
- 178. B. Grady, D. Schmidtke, A. Striolo, A. Cheville, D. Teeters, "Polymer Nanostructures on Solid Surfaces," \$208K (\$125K OU)
- 179. T. Conway, "E. coli Model Organism Resource," UN-Purdue, (\$685K OU)
- 180. R. Kolar, "Storm Surge Modeling in SE Louisiana - 2006," ARCADIS, (\$37K OU)
- 181. D. Cole (ORNL), A. Striolo, "Rates and Mechanisms of Mineral-Fluid Interactions at the Nanoscale," DOE, \$1.65M (total), (\$55K OU)
- 182. R. Kolar, "A Prototype Operational Modeling System for Waves, Coastal Currents, Inundation and Hydrologic Flooding for Eastern North Carolina," UN-UNC-CH, (\$209K OU)
- 183. R. Kolar, "A Coupled Regional-Coastal Ocean Model: HYCOM/CG-ADCIRC," DOD-NRL, (\$333K OU)
- 184. M. Xue, "Contribution to WRF Model Development by the Center for Analysis and Prediction of Storms," DOC-NOAA, \$821K
- 185. K. Marfurt, "Improving Geologic and Engineering Models of Midcontinent Fracture and Karst Modified Reservoirs Using 3-D Seismic Attributes," UKCRINC, (\$61K OU)
- 186. P. Attar, P. Vedula, "Novel, Optimal, Physics-based Reduced Order Models for Nonlinear Aeroelasticity," Advanced Dynamics, \$49K
- 187. S. Dhall, "Autonomous Data Partitioning using Data Mining for High Performance Computing," NSF, (\$125K OU)

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External Research Grants (cont'd)

- 188. M. Xue, K. Brewster, J. Gao, "Ensemble-based Data Assimilation for Tropical Storms, and Realtime 3DVAR Analysis for Initial Proof of 'Warn-on-Forecast' Concept: Collaborative Research between CAPS and NSSL," DOC-NOAA, \$100,000
- 189. M. Xue, "Contribution to Model Development and Enhancement Research Team by the Center for Analysis and Prediction of Storms," DOC-NOAA, \$620K
- 190. M. Xue, K. Brewster, "Ensemble-based Data Assimilation for Convective Storms and Hurricanes," DOC-NOAA, \$100,000
- 191. S. Schroeder, "Discovering Satellite Tobacco Mosaic Virus Structure," OCAST, \$85K
- 192. S. Schroeder, "Computational Advances Toward Predicting Encapsidated Viral RNA Structure," Pharmaceutical Research and Manufacturer's Association of America, \$60K
- 193. R. Kolar, "Outer Boundary Forcing for Texas Coastal Models," Texas Water Development Board, \$20K
- 194. K. Milton, "Collaborative Research: Quantum Vacuum Energy", NSF, \$250K
- 195. A. McGovern, "Developing Spatiotemporal Relational Models to Anticipate Tornado Formation," NSF, \$500K
- 196. Y. Kogan, "Midlatitude Aerosol-Cloud-Radiation Feedbacks in Marine Boundary Layer Clouds", ONR, \$638K
- 197. J. Straka, K. Kanak, Davies-Jones, "Challenges in understanding tornadogenesis and associated phenomena," NSF, \$854K (total), \$584K (OU)
- 198. Y. Hong, "Improvement of the NASA Global Hazard System and Implement Server-Africa," NASA, \$272K
- 199. J. Antonio, S. Lakshmivaran, H. Neeman, "Predictions of Atmospheric Dispersion of Chemical and Biological Contaminants in the Urban Canopy." Subcontract No. 1334/0974-01, Prime Agency DOD-ARO, Subcontract through Texas Tech University, Lubbock, TX, Sep. 29, 2000 to Nov. 3, 2001, \$75K
- 200. A. Striolo, "Electrolytes at Solid-Water Interfaces: Theoretical Studies for Practical Applications," OSRHE Nanotechnology, \$15K
- 201. D. Papavassiliou, "Turbulent transport in non-homogeneous turbulence," NSF, \$320K

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External Research Grants (cont'd)

- 202. K. Droegemeier et al., "Engineering Research Center for Collaborative Adaptive Sensing of the Atmosphere," NSF, \$17M (total), \$5.6M (OU)
- 203. K. Droegemeier et al., "Linked Environments for Atmospheric Discovery (LEAD)," NSF, \$11.25M (total), \$2.5M (OU)
- 204. M. Strauss, P. Skubic et al., "Oklahoma Center for High Energy Physics", DOE EPSCoR, \$3.4M (total), \$1.6M (OU)
- 205. M. Richman, A. White, V. Lakshmanan, V. DeBrunner, P. Skubic, "Real Time Mining of Integrated Weather Data," NSF, \$950K
- 206. D. Weber, K. Droegemeier, H. Neeman, "Modeling Environment for Atmospheric Discovery," NCSA, \$435K
- 207. H. Neeman, K. Droegemeier, K. Mish, D. Papavassiliou, P. Skubic, "Acquisition of an Itanium Cluster for Grid Computing," NSF, \$340K
- 208. J. Levit, D. Ebert (Purdue), C. Hansen (U Utah), "Advanced Weather Data Visualization," NSF, \$300K
- 209. D. Papavassiliou, "Turbulent Transport in Wall Turbulence," NSF, \$165K
- 210. L. Lee, J. Mullen (Worcester Polytechnic), H. Neeman, G.K. Newman, "Integration of High Performance Computing in Nanotechnology," NSF, \$400K
- 211. R. Wheeler, "Principal mode analysis and its application to polypeptide vibrations," NSF, \$385K
- 212. R. Kolar, J. Antonio, S. Dhall, S. Lakshmivaran, "A Parallel, Baroclinic 3D Shallow Water Model," DoD - DEPSCoR (via ONR), \$312K
- 213. R. Luettich (UNC), R. Kolar, B. Vieux, J. Gourley, "The Center for Natural Disasters, Coastal Infrastructure, and Emergency Management," DHS, \$699K
- 214. D. Papavassiliou, M. Zaman, H. Neeman, "Integrated, Scalable MBS for Flow Through Porous Media," NSF, \$150K
- 215. Y. Wang, P. Mukherjee, "Wavelet based analysis of WMAP data," NASA, \$150K
- 216. E. Mansell, C. L. Ziegler, J. M. Straka, D. R. MacGorman, "Numerical modeling studies of storm electrification and lightning," \$605K

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External Research Grants (cont'd)

- 217. K. Brewster, J. Gao, F. Carr, W. Lapenta, G. Jedlovec, "Impact of the Assimilation of AIRS Soundings and AMSR-E Rainfall on Short Term Forecasts of Mesoscale Weather," NASA, \$458K
- 218. R. Wheeler, T. Click, "National Institutes of Health/Predocorral Fellowships for Students with Disabilities," NIH/NIGMS, \$80K
- 219. K. Pathasarathy, D. Papavassiliou, L. Lee, G. Newman, "Drag reduction using surface-attached polymer chains and nanotubes," ONR, \$730K
- 220. D. Papavassiliou, "Turbulent transport in non-homogeneous turbulence," NSF, \$320K
- 221. C. Doswell, D. Weber, H. Neeman, "A Study of Moist Deep Convection: Generation of Multiple Updrafts in Association with Mesoscale Forcing," NSF, \$430K
- 222. D. Papavassiliou, "Melt-Blowing: Advance modeling and experimental verification," NSF, \$321K
- 223. R. Kol,ar et al., "A Coupled Hydrodynamic/Hydrologic Model with Adaptive Gridding," ONR, \$595K
- 224. D. Papavassiliou, "Scalar Transport in Porous Media," ACS-PRF, \$80K
- 225. M. Xue, F. Carr, A. Shapiro, K. Brewster, J. Gao, "Research on Optimal Utilization and Impact of Water Vapor and Other High Resolution Observations in Storm-Scale QPF," NSF, \$880K.
- 226. J. Gao, K. Droegemeier, M. Xue, "On the Optimal Use of WSR-88D Doppler Radar Data for Variational Storm-Scale Data Assimilation," NSF, \$600K.
- 227. K. Mish, K. Muraleetharan, "Computational Modeling of Blast Loading on Bridges," OTC, \$125K
- 228. V. DeBrunner, L. DeBrunner, D. Baldwin, K. Mish, "Intelligent Bridge System," FHWA, \$3M
- 229. D. Papavassiliou, "Scalar Transport in Porous Media," ACS-PRF, \$80K
- 230. Y. Wang, P. Mukherjee, "Wavelet based analysis of WMAP data," NASA, \$150K
- 231. R. Wheeler et al., "Testing new methods for structure prediction and free energy calculations (Predocorral Fellowship for Students with Disabilities)," NIH/NIGMS, \$24K
- 232. L. White et al., "Modeling Studies in the Duke Forest Free-Air CO2 Enrichment (FACE) Program," DOE, \$730K

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External Research Grants (cont'd)

- 233. Neeman, Severini, "Cyberinfrastructure for Distributed Rapid Response to National Emergencies", NSF, \$132K
- 234. Neeman, Roe, Severini, Wu et al., "Cyberinfrastructure Education for Bioinformatics and Beyond," NSF, \$250K
- 235. K. Milton, C. Kao, "Non-perturbative Quantum Field Theory and Particle Theory Beyond the Standard Model," DOE, \$150K
- 236. J. Snow, "Oklahoma Center for High Energy Physics", DOE EPSCoR, \$3.4M (total), \$169K (LU)
- 237. M. Xue, F. Kong, "OSSE Experiments for airborne weather sensors," Boeing, \$90K
- 238. M. Xue, K. Brewster, J. Gao, A. Shapiro, "Storm-Scale Quantitative Precipitation Forecasting Using Advanced Data Assimilation Techniques: Methods, Impacts and Sensitivities," NSF, \$835K
- 239. Y. Kogan, D. Mechem, "Improvement in the cloud physics formulation in the U.S. Navy Coupled Ocean-Atmosphere Mesoscale Prediction System," ONR, \$889K
- 240. G. Zhang, M. Xue, P. Chilson, T. Schuur, "Improving Microphysics Parameterizations and Quantitative Precipitation Forecast through Optimal Use of Video Disdrometer, Profiler and Polarimetric Radar Observations," NSF, \$464K
- 241. T. Yu, M. Xue, M. Yeay, R. Palmer, S. Torres, M. Biggerstaff, "Meteorological Studies with the Phased Array Weather Radar and Data Assimilation using the Ensemble Kalman Filter," ONR/Defense EPSCOR/OK State Regents, \$560K
- 242. B. Wanner, T. Conway, et al., "Development of the www.EcoliCommunity.org Information Resource," NIH, \$1.5M (total), \$150K (OU)
- 243. T. Ibrahim et al., "A Demonstration of Low-Cost Reliable Wireless Sensor for Health Monitoring of a Precast Prestressed Concrete Bridge Girder," OK Transportation Center, \$80K
- 244. T. Ibrahim et al., "Micro-Neural Interface," OCAST, \$135K
- 245. J. Snow, "Langston University High Energy Physics," \$155K (LU)

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External Research Grants (cont'd)

- 246. L.M. Leslie, M.B. Richman, C. Doswell, "Detecting Synoptic-Scale Precursors Tornado Outbreaks," NSF, \$548K
- 247. L.M. Leslie, M.B. Richman, "Use of Kernel Methods in Data Selection and Thinning for Satellite Data Assimilation in NWP Models," NOAA, \$342K
- 248. J. Gao, K. Brewster, M. Xue, K. Droegemeier, "Assimilating Doppler Radar Data for Storm-Scale Numerical Prediction Using an Ensemble-based Variational Method," NSF, \$200K
- 249. E. Chesnokov, "Fracture Prediction Methodology Based On Surface Seismic Data," Devon Energy, \$1M
- 250. E. Chesnokov, "Scenario of Fracture Event Development in the Barnett Shale (Laboratory Measurements and Theoretical Investigation)," Devon Energy, \$1.3M
- 251. M. Xue, K. Brewster, J. Gao, "Study of Tornado and Tornadoic Thunderstorm Dynamics and Predictability through High-Resolution Simulation, Prediction and Advanced Data Assimilation," NSF, \$780K
- 252. A. Striolo, "Heat Transfer in Graphene-Oil Nanocomposites: A Molecular Understanding to Overcome Practical Barriers." ACS Petroleum Research Fund, \$40K
- 253. D.V. Papavassiliou, "Turbulent Transport in Anisotropic Velocity Fields," NSF, \$292.5K
- 254. D. Oliver, software license grant, \$1.5M
- 255. R. Broughton et al, "Assembling the Eutelost Tree of Life – Addressing the Major Unresolved Problem in Vertebrate Phylogeny," NSF, \$3M (\$654K to OU)
- 256. A. Fagg, "Development of a Bidirectional CNS Interface or Robotic Control," NIH, \$600K
- 257. M. Xue, J. Gao, "An Investigation on the Importance of Environmental Variability to Storm-scale Radar Data Assimilation," NSSL, \$72K
- 258. JV. Sikavistsas and D.V. Papavassiliou , "Flow Effects on Porous Scaffolds for Tissue Regeneration," NSF, \$400K
- 259. P. Skubic, M. Strauss, et al., "Experimental Physics Investigations Using Colliding Beam Detectors at Fermilab and the LHC," DOE, \$503K

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External Funding Summary

- External research funding facilitated by OSCER (Fall 2001- Fall 2013): **\$259M total, \$145M to OU (56%)**
- Funded projects: **OVER 250**
- **134** OU faculty and staff in **21** academic departments and **6** non-academic units
- Comparison: Fiscal Year 2002-13 (July 2001 – June 2013):
OU Norman externally funded research expenditure: \$891M

Since being founded in fall of 2001, OSCER has enabled research projects comprising more than

1 / 7 of OU Norman's total externally funded research expenditure, with a 7-to-1 return on investment.



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Publications Facilitated by Research IT

- Publications facilitated by Research IT resources

- **2013: 128** (so far)
- 2012: 142
- 2011: 117
- 2010: 124
- 2009: 106
- 2008: 109
- 2007: 73
- 2006: 93
- 2005: 66
- 2004: 28
- 2003: 9
- 2002: 8
- 2001: 3

TOTAL SO FAR: 1006 publications

http://www.oscer.ou.edu/papers_from_rounds.php

Includes: 28 MS theses, 23 PhD dissertations



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Blue Ribbon Panel

- In August 2012, OU hosted a Blue Ribbon panel of experts from across the US, mostly academic but also industry, to help us understand how to strategize for the coming decade.
- Non-panelist participants included:
 - several dozen from OU;
 - about a dozen other Oklahoma institutions;
 - about a dozen institutions in 10 other EPSCoR jurisdictions;
 - about a dozen from institutions in non-EPSCoR jurisdictions.
- Major realization: collaboration!
 - with researchers, instead of only providing service;
 - among OU's CIO, VPR and Dean of Libraries.



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Oklahoma Cyberinfrastructure Initiative



2008-13



OCII Goals

- **Reach** institutions outside the mainstream of advanced computing.
- **Serve** every higher education institution in Oklahoma that has relevant curricula.
- **Educate** Oklahomans about advanced computing.
- **Attract** underrepresented populations and institution types into advanced computing.



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OCII Service Methodologies Part 1

- **Access (A)**: to supercomputers and related technologies (20 OK academic institutions to date).
- **Dissemination (D)**: Oklahoma Supercomputing Symposium – annual advanced computing conference (25 OK academic institutions to date).
- **Education (E)**: “Supercomputing in Plain English” (SiPE) workshop series: 11 talks about advanced computing, taught with stories, analogies and play rather than deep technical jargon. Have reached 248 institutions (academic, government, industry, nonprofit) in 47 US states and territories and 10 other countries (14 OK academic institutions to date).



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OCII Service Methodologies Part 2

- **Faculty/Staff Development (F)**: Workshops held at OU and OSU on advanced computing and computational science topics, sponsored by the National Computational Science Institute, the SC supercomputing conference series, the Linux Clusters Institute, the Virtual School for Computational Science & Engineering. Oklahoma is the only state to have hosted multiple events sponsored by each of these (18 OK academic to date).
- **Outreach (O)**: “Supercomputing in Plain English” (SiPE) overview talk (24 OK academic to date).
- **Proposal Support (P)**: Letters of commitment for access to OCII resources; collaborations with OCII lead institutions (4 OK academic, 1 nongovernmental).



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OCII Service Methodologies Part 3

- **Technology (T)**: Got or helped get technology (e.g., network upgrade, mini-supercomputer, hi def video camera for telepresence) for that institution (14 OK academic to date).
- **Workforce Development (W)** – (36 OK academic)
 - Oklahoma Information Technology Mentorship Program (OITMP)
 - “A Day in the Life of an IT Professional” presentations to courses across the full spectrum of higher education.
 - Job shadowing opportunities and direct mentoring of individual students.
 - Institution Types: high schools, career techs, community colleges, regional universities, PhD-granting universities.
- Special effort to reach underrepresented populations: underrepresented minorities, non-PhD-granting, rural



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OCII Institution Profile

To date, OCII has served 98 Oklahoma institutions, agencies and organizations:

- 50 OK academic
- 48 OK non-academic



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OCII Institution Profile

To date, OCII has served 98 Oklahoma institutions, agencies and organizations:

- 50 OK academic
 - Universities & Colleges
 - 3 comprehensive PhD-granting
 - 20 regional non-PhD-granting
 - Community Colleges: 10
 - Career techs: 12
 - Secondary schools: 3
 - Public school systems: 2
- 48 OK non-academic



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OCII Institution Profile

So far, OCII has served:

- 50 OK academic
 - 9 Minority Serving Institutions
 - 15 other institutions with above state average and national average for one or more underrepresented minorities
- 48 OK non-academic

Minority Serving Institutions

- Oklahoma's only Historically Black College or University
 - Langston U (Langston)
- Native American Serving Non-tribal Institutions
 - East Central U (Ada)
 - Northeastern Oklahoma A&M College (Miami)
 - Northeastern State U (Tahlequah)
 - Southeastern Oklahoma State U (Durant)
- Tribal Colleges
 - College of the Muscogee Nation (Okmulgee)
 - Comanche Nation College (Lawton)
 - Pawnee Nation College (Pawnee)
- Other Minority Serving Institution
 - Bacone College (Muskogee)



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OCII Institution Profile

To date, OCII has served 98 Oklahoma institutions, agencies and organizations:

- 50 OK academic institutions
- 48 OK non-academic organizations
 - 16 commercial
 - 19 government
 - 2 military
 - 11 non-governmental



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OCII Academic Institutions

1. **Bacone College (MSI, 28.3% AI, 27.3% AA): T**
2. **Cameron U (15.3% AA): A, D, E, F, O, T, W**
Taught advanced computing course using OSCER's supercomputer (multiple times).
3. **Canadian Valley Tech Center: W**
4. **College of the Muscogee Nation (Tribal): O, T**
5. **Comanche Nation College (Tribal): D, O, T**
6. **DeVry U Oklahoma City: D, F, O**
7. **East Central U (NASNI, 17.9% AI, rural): A, D, E, F, O, P, T, W**
Taught advanced computing course using OSCER's supercomputer.
8. **Eastern Oklahoma State College (23.7% AI): W**
Average: ~3 (mean 3.4, median 3, mode 1)
9. **Eastern Oklahoma County Tech Center (10.4% AI): W**
10. **Elgin Middle School: O (tour only)**
11. **Francis Tuttle Tech Center: D, T, W**
12. **Gordon Cooper Tech Center (15.6% AI, nonmetro): D, O, W**
13. **Great Plains Tech Center (11.1% AI): W**
14. **Kiamichi Tech Center (18.8% AI): T, W**
15. **Langston U (HBCU, 81.6% AA): A, D, E, F, O, P, T, W**
NSF Major Research Instrumentation grant for supercomputer awarded in 2012.

Note: Langston U (HBCU) and East Central U (NASNI) are the only two non-PhD-granting institutions to have benefited from every category of service that OCII provides.

AA = African American (7.47 OK population, 13.1% US population)
 AI = American Indian (8.9% OK, 1.2% US)
 H = Hispanic (9.2% OK, 16.7% US)
 ALL = 25.8% OK, 31.0% US

HBCU: Historically Black College or University
 NASNI = Native American Serving Non-Tribal Institution
 MSI = Minority Serving Institution



OSCER State of the Center Address
 Wed Oct 2 2013





OCII Academic (cont'd)

16. Lawton Christian School (high school): W

17. Metro Tech Centers (28.2% AA): D

18. Mid-America Tech Center: D, W

19. Mid-Del Public Schools: D

20. Moore Norman Tech Center: D, W

21. Northeast Tech Center (22.1% AI): W

22. Northeastern Oklahoma A&M College (NASNI, 22.8% AI): T, W

23. Northeastern State U (NASNI, 27.2% AI, nonmetro): A, D, E, F, O, T, W
Taught computational chemistry course using OSCER's supercomputer (multiple).

24. Northwestern Oklahoma State U: A, F, O

25. Oklahoma Baptist U (nonmetro): A, D, E, F, O, T, W

26. Oklahoma Christian U: W

27. Oklahoma City Community College: W

28. Oklahoma City U: A, D, E, F, O, T, W

Educational Alliance for a Parallel Future mini-supercomputer proposal funded in 2011.

Taught advanced computing course using OSCER's supercomputer (multiple).

29. Oklahoma Panhandle State U (rural): A, D, O, W

30. Oklahoma School of Science & Mathematics (high school): A, D, E, O, W

31. Oklahoma State U (PhD, 8.3% AI): A, D, E, F, O, P, T, W

NSF Major Research Instrumentation proposal for supercomputer funded in 2011.

32. Oklahoma State U Institute of Technology (community college, 21.4% AI): W

Average: ~3 (mean 3.4, median 3, mode 1)

AA = African American (7.7% OK population, 13.1% US population)

AI = American Indian (8.9% OK, 1.2% US)

H = Hispanic (9.2% OK, 16.7% US)

ALL = 25.8% OK, 31.0% US

HBCU: Historically Black College or University

NASNI = Native American Serving Non-Tribal Institution

MSI = Minority Serving Institution



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OCII Academic (cont'd)

33. **Oklahoma State U OKC (16.2% AA, comm college): O, T, W**

34. Oral Roberts U: A, F, O, W

35. Panola Public Schools: D

36. **Pawnee Nation College (Tribal): T**

37. **Pontotoc Tech Center (34.1% AI): T, W**

38. **Rogers State U (13.6% AI): A, D, F, O**

39. **Rose State College (17.4% AA): F, W**

40. St. Gregory's U (nonmetro): A, D, E, F, O

41. **Southeastern Oklahoma State U (NASNI, 26.0% AI, nonmetro): A, D, E, F, O, T, W**
*Educational Alliance for a Parallel Future mini-supercomputer grant **funded** in 2011.*

42. Southern Nazarene U: A, D, F, O, P, T, W
Teaching computational chemistry course using OSCER's supercomputer.

43. Southern Tech Center: T, W

44. Southwestern Oklahoma State U (rural):
A, D, E, F, O, T, W

Teaching advanced computing course using OSCER's supercomputer (multiple).

45. Tulsa Community College: W

46. U Central Oklahoma: A, D, E, F, O, P, W

NSF Major Research Instrumentation proposal for supercomputer submitted in 2011-13.

47. U Oklahoma (PhD): A, D, E, F, O, P, T, W

*NSF Major Research Instrumentation grant for large scale storage **funded** in 2010.*

48. U Phoenix: D

49. **U of Science & Arts of Oklahoma (9.7% AI): A, O**

50. U Tulsa (PhD): A, D, E, F, O, P, T, W

Taught bioinformatics course using OSCER's supercomputer.

AA = African American (7.7% OK population, 13.1% US population)

AI = American Indian (8.9% OK, 1.2% US)

H = Hispanic (9.2% OK, 16.7% US)

ALL = 25.8% OK, 31.0% US

HBCU = Historically Black College or University

NASNI = Native American Serving Non-Tribal Institution

MSI = Minority Serving Institution

Average: ~3 (mean 3.4, median 3, mode 1)



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OCII Non-academic

■ Commercial (16)

1. Andon Corp : D, F
2. Chesapeake Energy Corp : D
3. Creative Consultants : D
4. Fusion Geophysical: D
5. Indus Corp: D, E
6. Information Technologic: D
7. KANresearch: D
8. KeyBridge Technologies: D
9. Lumenate: D
10. OGE Energy Corp: D
11. Perfect Order (now defunct): D
12. PowerJam Production Inc: D
13. Versatile: D
14. Visage Production Inc: D, E
15. Weather Decision Technologies Inc : A
16. Weathernews Americas Inc.: A, D

■ Government (19)

1. City of Duncan: D
2. City of Edmond: D
3. City of Nichols Hills: D
4. City of Tulsa: E
5. NOAA National Severe Storms Laboratory: A, D, E, F
6. NOAA Storm Prediction Center: D
7. NOAA National Weather Service: D
8. NOAA Radar Operations Center: D
9. OK Climatological Survey: D
10. OK Department of Health: D, E
11. OK Department of Human Services: D, E
12. OK Department of Libraries: D
13. OK Department of Mental Health and Substance Abuse Services: D
14. OK Office of State Finance: D
15. Oklahoma State Chamber of Commerce: D
16. OK State Regents for Higher Education: A, D, T
17. OK State Supreme Court: D
18. OK Tax Commission: D
19. Tulsa County Court Services: D



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Wed Oct 2 2013





OCII Non-academic (cont'd)

- Military (2)
 1. Fort Sill Army Base: E
 2. Tinker Air Force Base: A, D, E, F, O
- Non-governmental/non-profit (11)
 1. American Society of Mechanical Engineers, Oklahoma City chapter: O
 2. Engineering Club of Oklahoma City: O
 3. Lions Club of Norman OK: O
 4. Lions Club of Shawnee OK: O
 5. Norman Science Café: O
 6. Oklahoma EPSCoR: D
 7. Oklahoma Historical Society: D
 8. Oklahoma Innovation Institute/Tulsa Research Partners: A, D, E, O, P
 9. Oklahoma Medical Research Foundation: A, D, P
 10. Oklahoma Nanotechnology Initiative: D
 11. Samuel Noble Roberts Foundation (**rural**): A, D, E, F, T



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Wed Oct 2 2013





OCII Outcomes: Research

- External research funding to OK institutions facilitated by OCII lead institutions (Fall 2001- Summer 2013): **over \$150M**
- Funded projects facilitated: **over 250**
- OK faculty and staff: **over 130** in **~20** academic disciplines
- Specifically needed OCII just to be funded: **over \$41M** (necessary but far from sufficient)
 - NSF EPSCoR RII Track-1 (2008-13): \$15M to OK
 - NSF EPSCoR RII Track-1 (2013-18): \$20M to OK (+\$4M Regents)
 - NSF EPSCoR RII Track-2: \$3M to OK
 - NSF EPSCoR RII C2: \$1.17M to OK
 - NSF MRI (OU): \$793K
 - NSF MRI (OSU): \$908K
 - NSF MRI (Langston U): \$250K
- Publications facilitated: **over 1000**



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Wed Oct 2 2013





OCII Outcomes: Education

Teaching: 9 institutions including 3 MSIs

- Teaching/taught parallel computing using OCII resources:
 - Cameron U – multiple times
 - East Central U (NASNI)
 - Oklahoma City U – multiple times
 - Southwestern Oklahoma State U (this summer)
- Taught parallel computing via LittleFe baby supercomputer:
 - Southeastern Oklahoma State U (NASNI) – multiple times
- Taught computational chemistry using OSCER resources:
 - Northeastern State U (NASNI) – multiple times
 - Southern Nazarene U
 - Rogers State U – multiple times
- Taught Bioinformatics using OCII resources:
 - U Tulsa – 2 semester sequence

C. Carley, B. McKinney, L. Sells, C. Zhao and H. Neeman, 2013: “Using a Shared, Remote Cluster for Teaching HPC.”

Proc. IEEE Cluster 2013.



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Wed Oct 2 2013





OCII Outcomes: Resources

6 institutions including 2 MSIs, plus C2 institutions

- NSF Major Research Instrumentation grants: \$1.95M
 - OU: Oklahoma PetaStore, \$793K (in production)
 - Oklahoma State U: Cowboy cluster, \$909K (in production)
 - Langston U: cluster, \$250K (recently deployed)
- LittleFe baby supercomputer grants (\$2500 each)
 - OU: Ron Barnes
 - Oklahoma City U: Larry Sells & John Goulden
 - Southeastern Oklahoma State U: Mike Morris & Karl Frinkle
- Networking: C2 grant: \$1.17M



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Wed Oct 2 2013





OK Optical Initiative (NSF EPSCoR C2)

■ Hardware

- Statewide Ring upgrade: replaced routed mux/demuxes with Reconfigurable Optical Add Drop Modules: much less expensive and much more straightforward to add new 10G circuits.
- Institutional upgrades
 - OU and OSU: cluster upgraded to 10G shared from GigE (10X), now being upgraded to 20G (2 x 10G) dedicated (20X), which is connected to Internet2's 100G Innovation Platform backbone.
 - OU: new mini-Science DMZ.
 - U Tulsa: upgraded to GigE from 200 Mbps (5X).
 - Samuel Roberts Noble Foundation: (private non-profit research institutions): upgraded to GigE from 45 Mbps for research (22X), 100 Mbps for commodity (2X)



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OK Optical Initiative (NSF EPSCoR C2)

- Hardware (continued)
 - Institutional Upgrades (continued)
 - Langston U (Oklahoma's only Historically Black College or University): upgraded to 10G from 100 Mbps (100X) for research.
 - Bacone College (Minority Serving Institution): campus backbone upgraded to 100 Mbps with GigE core from 10 Mbps (10X upgrade).
 - College of the Muscogee Nation (Tribal): network core for new residence hall.
 - Comanche Nation College (Tribal) distance learning system.
 - Pawnee Nation College (Tribal) Internet radio station, distance learning system, campus backbone upgrade to GigE.
 - OK IT Mentorship Program



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OK Optical Initiative Side Effects

- 100G connection to Internet2's Innovation Platform
- OU+OSU Shared Services initiative: leveraging C2 investments to create enterprise IT collaborations both within and between the institutions.
 - OU Virtual data center – highly robust
 - Virtualized services
 - Substantial savings from shared infrastructure and shared purchasing vehicles.
 - **NOT AT ALL FUNDED BY C2.**
 - But, leverages C2 capabilities – if not for the C2, Shared Services would have had to make the exact same investments in the state ring.



OSCER State of the Center Address
Wed Oct 2 2013





OCII HPC (2008-12)

Just over 40 TFLOPs of HPC capacity across the state:

- OU: 34.5 TFLOPs (internally funded)
- OSU: 6.3 TFLOPs (internally funded)



OSCER State of the Center Address
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Education, Outreach, Training, etc

- Education
 - Supercomputing in Plain English (SiPE)
- Outreach
 - SiPE Overview Talk, Cyberinfrastructure tours
- Training
 - Various technology trainings (run by vendors)
- Faculty/Staff Development
 - Summer workshops
- Workforce Development
 - Oklahoma IT Mentorship Program



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Supercomputing in Plain English

- **FREE and OPEN TO ALL**
- Provided every other spring (most recently Spring 2013)
- Available LIVE via videoconferencing
- Topics <http://www.oscer.ou.edu/education/>
 1. Overview: What the Heck is Supercomputing?
 2. The Tyranny of the Storage Hierarchy
 3. Instruction Level Parallelism
 4. Stupid Compiler Tricks
 5. Shared Memory Multithreading
 6. Distributed Multiprocessing
 7. Application Types and Parallel Paradigms
 8. Multicore Madness
 9. High Throughput Computing
 10. GPGPU: Number Crunching in Your Graphics Card
 11. Grab Bag: Scientific Libraries, I/O Libraries, Visualization



OSCI State of the Center Address
Wed Oct 2 2013





SiPE Participants

- 248 institutions, firms, agencies and organizations in 47 US states & territories and 10 other countries
 - Academic: 178 institutions in 46 US states & territories and 6 other countries
 - 69 institutions in 23 EPSCoR jurisdictions
 - 15 institutions in Oklahoma
 - Industry: 26 firms in the US and 1 other country
 - Government: 29 – US federal and state plus 4 other countries
 - Non-Governmental: 15 (US and 1 other country)
- Missing US states & territories
 - EPSCoR states: MT, NH, RI, VT, WY
 - EPSCoR territories: US Virgin Islands, Guam (no PhD-granting)
 - Other territories: American Samoa, Northern Marianas Islands



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Outreach: Presentations & Tours

■ Courses at OU

1. Chem Engr: Industrial & Environmental Transport Processes (D. Papavassiliou)
2. Engineering Numerical Methods (U. Nollert)
3. Math: Advanced Numerical Methods (R. Landes)
4. Electrical Engr: Computational Bioengineering (T. Ibrahim)

■ Research Experience for Undergraduates at OU

1. Ind Engr: Metrology REU (T. Reed Rhoads)
2. Ind Engr: Human Technology Interaction Center REU (R. Shehab)
3. Meteorology REU (D. Zaras)

■ External

1. American Society of Mechanical Engineers, OKC Chapter
2. Engineering Club of Oklahoma City
3. Association for Computing Machinery (ACM) Special Interest Group on Computer Science Education (SIGCSE) 2010
4. Oklahoma State Chamber of Commerce
5. National Educational Computing Conference 2006 (virtual tour via videoconference)
6. Norman (OK) Lions Club
7. Society for Information Technology & Teacher Education conference 2008, 2009, 2010
8. Axiom Conference on Applied Research in Information Technology 2008
9. Shawnee (OK) Lions Club
10. Oklahoma Louis Stokes Alliance for Minority Participation (@ OSU) 2010 (Keynote)
11. Norman (OK) Science Café
12. Tech Forum Texas 2010
13. Texas Computer Education Association 2011
14. Tinker Air Force Base
15. Consortium for School Networking 2011
16. Consortium for Computing Sciences in Colleges 2011 (Keynote)
17. SC07-13

■ Other Universities

1. SUNY Binghamton (NY)
2. Bradley University (IL)
3. Cameron University (OK)
4. The Citadel (SC)
5. College of the Muscogee Nation (OK)
6. Comanche Nation College (OK)
7. DeVry University (OK)
8. East Central University (OK)
9. El Bosque University (Bogota Colombia)
10. Southwestern University (TX)
11. Langston University (OK)
12. Louisiana State University
13. Midwestern State University (TX)
14. Northeastern Oklahoma State University
15. Northwestern Oklahoma State University
16. Oklahoma Baptist University
17. Oklahoma City University
18. Oklahoma State University x 2
19. Oklahoma State University – OKC
20. Oral Roberts University (OK) x 2
21. Rogers State U (OK)
22. Philander Smith College (AR)
23. St. Gregory's University (OK) x 2
24. Southeastern Oklahoma State University x 2
25. Southern Nazarene University (OK)
26. Southwestern Oklahoma State University x 2
27. Texas A&M-Commerce
28. University of Arkansas Fayetteville
29. University of Arkansas at Little Rock
30. University of Arkansas at Pine Bluff
31. University of Central Oklahoma
32. University of Oklahoma-Tulsa
33. University of Science & Arts of Oklahoma
34. University of Texas Brownsville
35. University of Tulsa (OK)

■ High Schools and High School Programs

1. Oklahoma School of Science & Mathematics x 2
2. Oklahoma Christian University's Opportunity Bytes Summer Academy
3. Dept of Energy National Scholarship Finalists
4. Ardmore High School (OK)
5. Elgin Middle School



OSCER State of the Center Address

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Fac/Staff Dev: Summer Workshops

- National Computational Science Institute workshops
 - Intro to Parallel Programming & Cluster Computing weeklong: summer 2004, summer 2005, summer 2008, summer 2009, summer 2012
 - Intro to Parallel Programming & Cluster Computing daylong: fall 2003, fall 2007-11
 - Intermediate Parallel Programming & Cluster Computing weeklong: summer 2010, summer 2011
 - LittleFe baby supercomputer buildout (summer 2011 – first ever anywhere; summer 2012)
 - Computational Chemistry for Chemistry Educators weeklong: summer 2009, summer 2011
 - Many of these were co-sponsored by Oklahoma EPSCoR (2008-2012) and/or the SC Education Program (2007-9, 2011)



OSCER State of the Center Address
Wed Oct 2 2013





Fac/Staff Dev: Summer Workshops

- Linux Clusters Institute workshops: June 2005, Feb 2007
- Virtual School for Computational Science & Engineering weeklong
 - 2012: Programming Heterogeneous Parallel Computing Systems; Proven Algorithmic Techniques for Many-core Processors (both on GPU computing)
 - 2013: Data Intensive Summer School (big data)
- Software Carpentry Bootcamp (2013): Python, scripting, version control etc
- Bioinformatics weeklong (2012)
- SUMMARY: Every summer 2004-2013 except 2006, 2007.



OSCER State of the Center Address
Wed Oct 2 2013





OK IT Mentorship Program

The Oklahoma Information Technology Mentorship Program is sending networking professionals to universities, colleges, career techs and even a high school statewide.

These professionals will give talks on the practicalities of being a networking professional – what that career choice means day by day.

We also provide both live and virtual job shadowing opportunities – students can follow networking professionals around to see what their work looks like, either in person or via Twitter and Facebook.

So far we've done 83 visits or reverse visits for 36 institutions.



OSCER State of the Center Address
Wed Oct 2 2013



OneOklahoma
Cyberinfrastructure
Initiative
2013-18



OneOklahoma Cyberinfrastructure Initiative

• OPSU

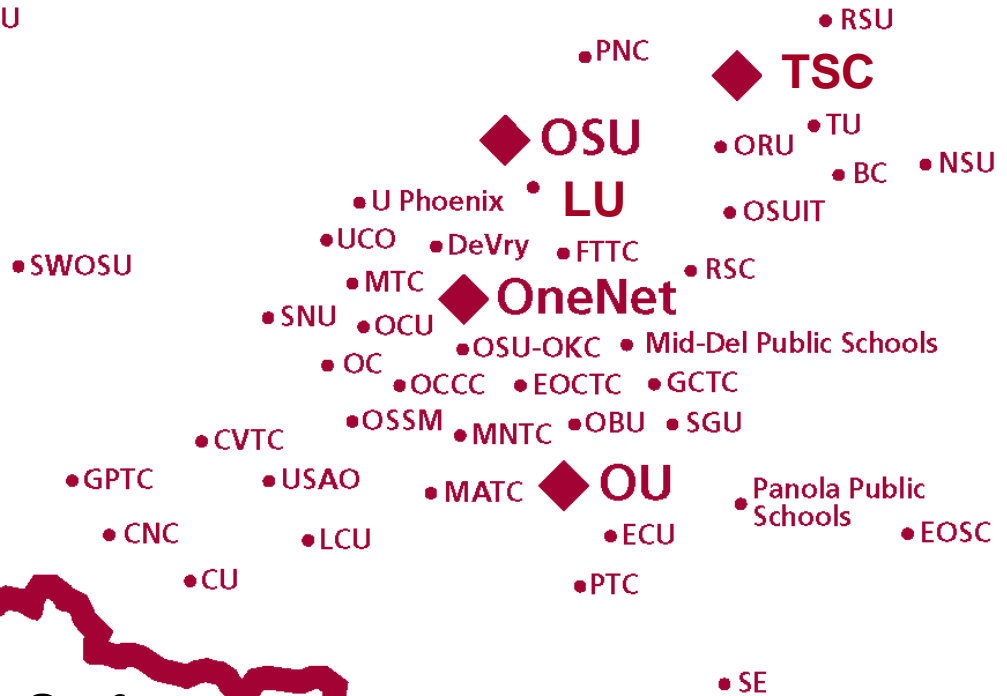
• NWOSU

• RSU

2013-18

Resource Providers: OU, OSU, TSC, Langston (HBCU, HEP)

- All OCII Services
- Informatics: Research facilitators (NOT researchers) who embed in specific research teams . Expands Informatics team from just OU to OSU, available to others statewide.
- cyberCommons: adaptable Big Data environment developed under OK-KS Track-2 (2009-13).
- Data Stewardship Initiative: collaboration among CI and Libraries.
- OK STEM Mentorship Program: extended OK IT Mentorship Program to other STEM disciplines.



So far:
50 OK academic
48 OK non-academic

OSCER State of the Center Address
 Wed Oct 2 2013





NEW! OneOCII

All of OCII, plus:

- Informatics professionals: research facilitators embedded in specific research projects (and largely funded by them)
- CyberCommons (from old NSF EPSCoR RII Track-2 grant)
 - Software platform for end-to-end research workflow support
- **NEW!** Physical resources
 - Research Clouds: research teams can buy virtual servers
 - Hadoop cluster
- **NEW!** Data Stewardship Initiative (led by Libraries)
- Oklahoma STEM Mentorship Program (not just IT) – already 20 institutions signed up, including 3 new



OSCER State of the Center Address
Wed Oct 2 2013





NEW! NSF EPSCoR RII Track-1

- “Adapting Socio-ecological Systems to Increased Climate Variability”
- OU, OSU, U Tulsa, Noble Foundation
- \$24M (\$20M NSF, \$4M State Regents) over 5 years
- Includes just under \$1M for Informatics
 - OU: heavy in Year 1 and first half of Year 2, light thereafter
 - OSU: nothing in Year 1 and first half of Year 2, 1 FTE thereafter
 - Sustainability plan, in place, guarantees at least through 2021



OSCER State of the Center Address
Wed Oct 2 2013





OneOCII HPC

Just over 200 TFLOPs of HPC capacity across the state
(5X increase from 2008-12)

- OU: 111.6 TFLOPs, acquired 2012 (internally funded)
- OSU: 48.8 TFLOPs, acquired 2012 (NSF MRI)
- Langston U: 8 TFLOPs CPU, 18.72 TFLOPs GPU, acquiring 2013 (NSF MRI)
- Tandy Supercomputing Center (Tulsa): 34.56 TFLOPs, acquired 2013 (independently of OCII/OneOCII)



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OK STEM Mentorship Program

- **NEW!** Starting Fall 2013
- Already have presenters signed up for:
 - Agriculture
 - Earth Sciences
 - Atmospheric Sciences: Meteorology
 - Ecological Sciences: Ecology, Rangeland Ecology, Urban Ecology
 - Geographical Sciences: Geography, Geographic Information Systems
 - Engineering: IT/CS
 - Libraries
 - Life Sciences: Plant Biology
 - Social Sciences: Anthropology, Economics, Political Science



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OneOklahoma

Friction Free

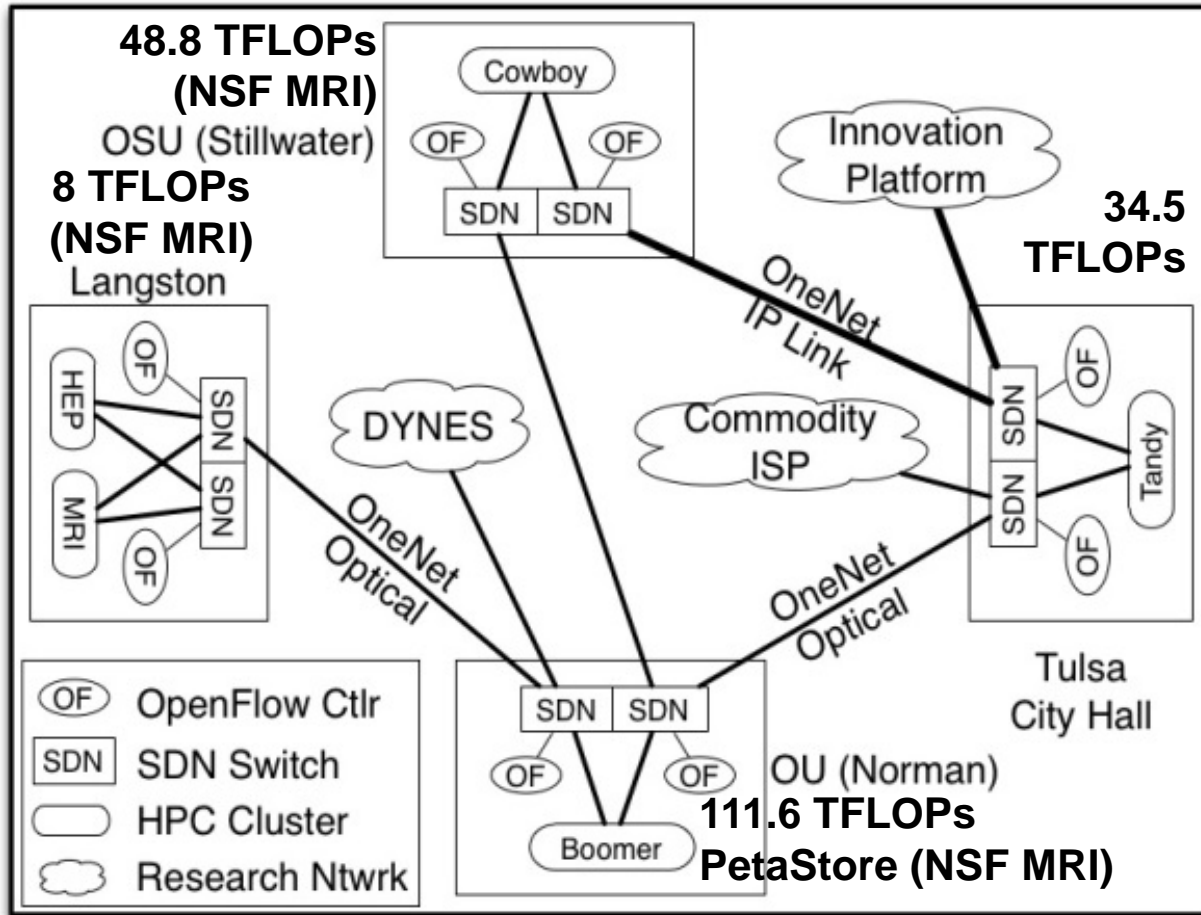
Network

2013-15





NSF CC-NIE Grant (Just Awarded)



OneOklahoma Friction Free Network (OFFN)

- Multi-institutional Science DMZ
- Software Defined Networking
- Dedicated 10G among the participating sites
- Aggregate compute: just over 200 TFLOPs (peak)



OSCER State of the Center Address
Wed Oct 2 2013





Objectives

1. Deploy and maintain, at the four institutions, a research-only network consisting of institutional last mile components that are independent of enterprise networks, with its internal hub collocated with OneNet.
2. Apply Software Defined Networking (SDN) across OFFN, facilitating end-to-end management, by researchers, of high bandwidth/high performance data flows through a distributed hierarchy of open standards tools, giving researchers a new layer of transparency into network transport.
3. Provide these capabilities – OFFN's in particular and OneOCII's in general – to all relevant researchers and educators statewide, and facilitate their use.



OSCER State of the Center Address
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Initial Science Drivers

- High Energy Physics (ATLAS, DØ): OU, LU, OSU
- Real Time Numerical Weather Prediction: OU
- Weather Radar: OU
- Bioinformatics: OSU
- ... with more to come.

Identified aggregate bandwidth: 23+ Gbps (when everything is going full tilt at the same time)



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Science Driver: High Energy Physics

- Senior Personnel
 - H. Severini (OU)
 - P. Skubic (OU)
 - J. Snow (LU)
 - M. Strauss (OU)
- Oklahoma Center for High Energy Physics (OCHEP)
- Funding: \$1.7M current, \$1M planned (NSF, DOE, Fermilab)
- 7 faculty, 2 staff, 4 postdocs, 3 graduate students
- Identified bandwidth need: up to 8 Gbps sustained



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Science Driver: High Energy Physics

- OU and LU already do a lot of ATLAS computing (data analysis and Monte Carlo simulation).
- OU, LU and OSU constitute the Oklahoma Center for High Energy Physics (OCHEP).
 - OSU physicists aren't doing computational.
- OU, LU and U Texas Arlington constitute the NSF's ATLAS Southwest Tier2 Center (SWT2), which is consistently in the top 3 most productive US academic Tier2 sites (OU is consistently #6-#8 most productive US academic institution).
- OSU and TSC have agreed to provide their idle cycles for ATLAS jobs, but will kill them off in favor of local jobs.



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Science Driver: Weather Prediction

- OU Center for Analysis & Prediction of Storms (CAPS)
- Senior Personnel
 - M. Xue (CAPS Director and faculty in OU's School of Meteorology)
 - K. Brewster (CAPS Associate Director)
- Funding: \$2.5M per year current, \$1M per year planned (NSF, NOAA)
- 6 faculty, 10 staff, 20 graduate students
- Identified bandwidth need: 12 Gbps sustained (during the annual Spring Realtime Storm Forecasting Experiment, mid-March – mid-June)



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Science Driver: Weather Radar

- Advanced Radar Research Center (ARRC)
- Senior Personnel: Tian-You Yu et al
- Funding: \$10M current, \$5M pending, \$25M planned (NOAA, NSF, NASA, industry)
- 15 faculty, 2 staff, 11 postdocs, ~60 graduate students, ~10 undergraduates
- Identified bandwidth need: 1.5 Gbps sustained



OSCAR State of the Center Address
Wed Oct 2 2013





Science Driver: Bioinformatics

- OSU Bioinformatics program
- Senior Personnel Elshahed (OSU), Hoyt (OSU)
- Funding: \$6.1M current, \$4.4M pending (NSF, NIH, USDA, DOD, US Army, OCAST, OK Ag Experiment Station)
- 14 faculty, 6 postdocs, 35 graduate students
- Identified bandwidth need: likely 1.6+ Gbps – lesser of (a) bandwidth of OSU HPC cluster disk or (b) bandwidth of Oklahoma PetaStore disk



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Network Deployment Goals

- Provide a proven, commercial off-the-shelf (COTS) hardware platform backed with vendor support.
- Realize the Science DMZ goals through the use of a truly independent network at each campus site.
 - The network deployment will consist of dedicated optical pathways to the optical transport provider (OneNet), as well as to the local campus backbone where desired.
- Deploy a fully virtualized infrastructure, to be used simultaneously by multiple research entities, presented to each entity as a dedicated “slice” of the overall resource.
- Leverage federation to provide oversight and visibility into the operations of the virtualized platform.



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Network Deployment Goals (cont'd)

- Realize the full potential of OFFN through awareness, training, site-specific hand-off, and communities of support for OFFN adopters.



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State Diagram (Conceptual)

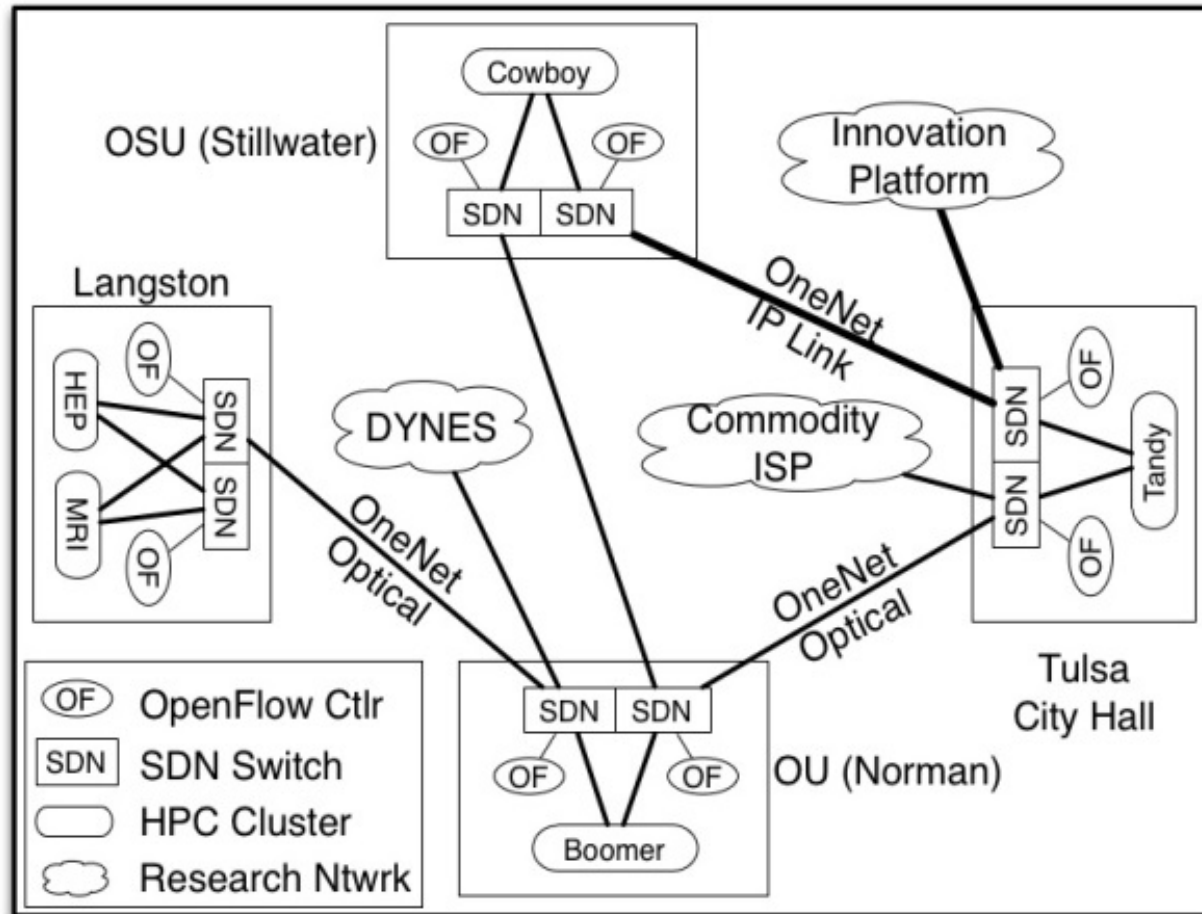


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State Diagram (Logical)



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Institutional Design

- SDN switches provide a virtualized data plane resource, to effectively and efficiently forward Ethernet traffic based on rules configured on the SDN controller. (Note that TSC will use a 24-port SDN-capable Brocade linecard instead.)
- Platform support switches provide the connectivity required for out-of-band management functions, including server lights-out management, SDN switch component management, and Virtual Machine (VM) host management.



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Institutional Design (cont'd)

- Servers provide multiple virtualized SDN controller resources, plus a virtualized platform for providing performance toolsets, management and monitoring utilities, and data transfer tools (e.g., perfSonar).
- Software (all Open Source and/or free)
 - OS virtualization platform (Xen, VirtualBox or Qemu)
 - Linux host and guest OS (Fedora or CentOS)
 - SDN controller (Beacon or Floodlight)
 - Performance testing (iPerf and the PSPerformance Toolkit)
 - Monitoring (Cacti or Nagios)

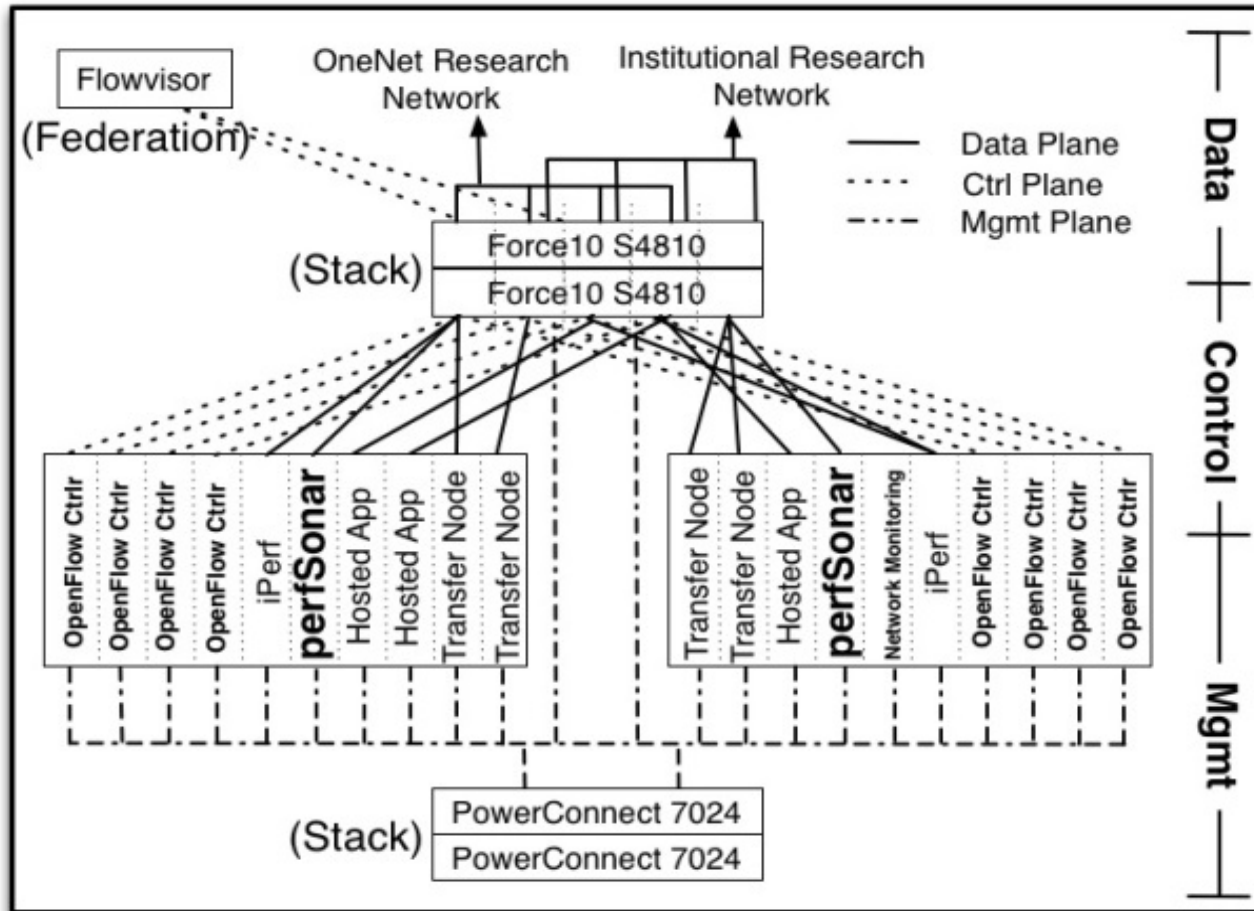


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Institutional Diagram (Logical)

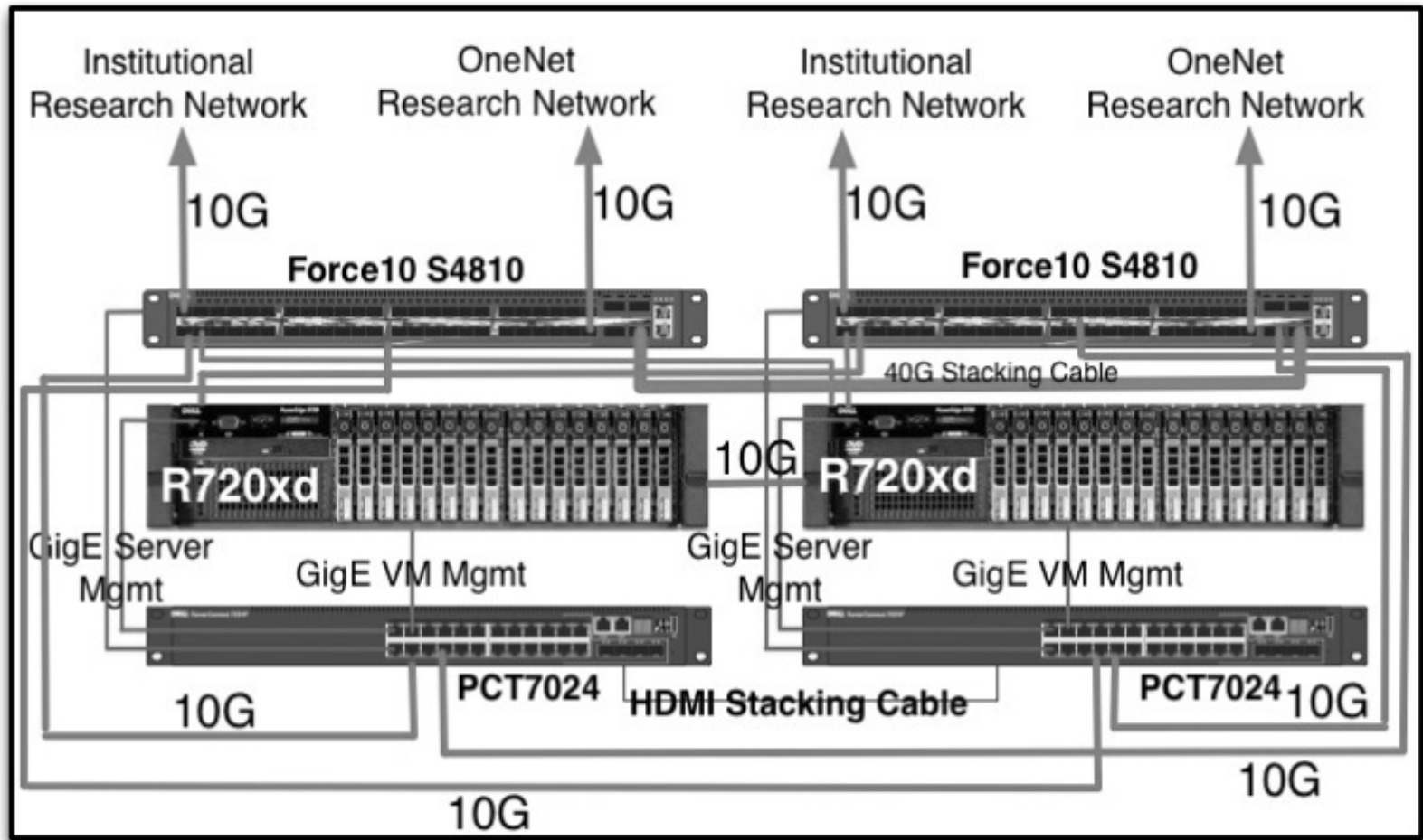


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Institutional Diagram (Physical)



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External Connectors

- **Innovation Platform**: OneNet has secured a 100G connection onto Internet2's Innovation Platform (IP).
 - OSU has dedicated connectivity to connect to the IP at 100G.
 - OU is deploying 2 x 10G with Layer-2 and Layer-3 transport services, from OU to OneNet, connecting directly into the same OneNet chassis as the IP. Under OFFN, researchers statewide will straightforwardly be able to access the IP via OU and OSU.
- **DYNES**: OU hosts a “static” DYNES site deployment.
 - Primarily implemented as a dedicated path tool for OUHEP's SWT2 cluster to receive large datasets from LHCOne.
 - Can easily be migrated to the 4PP Science DMZ.



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External Connectors (cont'd)

- **XSEDE**: OU's already-funded plan to connect to the Innovation Platform can also facilitate connection to XSEDEnet at no additional charge, by OneNet simply setting aside 10 Gbps of the 100 Gbps connection into the Innovation Platform (subject to OneNet's and XSEDE's approval).
- **PlanetLab** provides an overlay services network that can be decomposed into tangible resource pools used for network experimentation. Both OU and OSU provide dedicated PlanetLab hardware resources.



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Thank You!

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 - Silver: DLT Solutions, GovConnection, Red Hat, Tangent
 - Bronze: Advanced Clustering Technologies, DataDirect Networks, Open Technologies, SGI

Thank you all! Without you, the Symposium couldn't happen.



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- Kevin Paschal, CommScope



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- George Louthan, Oklahoma Innovation Institute
- Greg Monaco, Great Plains Network
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Thanks!

To all of you for participating, and to those many of you who've shown us so much loyalty over the past 12 years.



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Questions?